Policy Brief
Issue n°35/24 | December 2024

Finance for nature: how to improve funding for the protection of biodiversity

Heather Grabbe and Luca Léry Moffat

Executive summary

THE ECONOMICS OF BIODIVERSITY are still little understood and the loss of nature, which provides pollination, clean water and other ecosystem services, is often considered to have primarily local economic impact. But nature has an intrinsic value and also has extrinsic value to many parts of the economy. Destruction of nature has global costs because nature loss accelerates climate change by releasing greenhouse gases into the atmosphere, causes water stress and crop failures that reduce food exports, and can force people to move. Some of the consequences are systemic. Others are long term, because potential solutions to human problems contained in intact ecosystems, such as medicines and bio-technologies, are lost to future generations.

THE BENEFITS FROM NATURE – and particularly biodiversity – do not result in revenue flows that would protect natural capital assets from degradation. The costs of ecosystem destruction are still largely unaccounted for. Finance for biodiversity is very small relative to what is required for its maintenance. Most of the sources are state or public funds, or from private philanthropy. Because biodiversity is complex and has largely been ignored as an economic issue, market mechanisms are still at an early stage of development. Nature still does not appear on many balance sheets, and nor is it integrated into risk assessments across the public and private sectors.

THIS POLICY BRIEF SUMMARISES the options and outlines the main considerations in finding better ways to value nature. We explain why financial tools are important for biodiversity, give an overview of the range of tools developed to finance ecosystems and assess which would be most suitable to pursue at European Union level. The focus in developing existing and new tools should be on whether they can deliver reliable revenue streams over a long period to maintain the value of natural assets. In the EU, the most impactful immediate means of using financing to protect and restore nature is to defund the damage caused to biodiversity by eliminating nature-harming subsidies, starting with reform of the common agricultural policy.

Heather Grabbe (heather.grabbe@bruegel.org) is a Senior Fellow at Bruegel

Luca Léry Moffat (luca.moffat@bruegel.org) is a Research Analyst at Bruegel

This Policy Brief was written with the financial support of the Heinrich-Böll-Stiftung European Union. The analysis and opinions expressed in this Policy Brief do not necessarily reflect the views of the Heinrich-Böll-Stiftung European Union.

Recommended citation
Grabbe, H. and L. Moffat (2024) 'Finance for nature: how to improve funding for the protection of biodiversity', *Policy Brief* 35/2024, Bruegel

bruegel

1 Why finance is important for nature and nature is important for finance

Biodiversity is the variety of ecosystems, species and genes in the world or in a particular habitat. Biodiversity, rather than just the count of species, enables nature to be productive, resilient and adaptable. Just as diversity within a portfolio of financial assets reduces risk and uncertainty, so diversity within a portfolio of natural assets increases resilience to shocks, reducing the risks to the services that nature provides (Dasgupta, 2021).

Biodiversity is crucial to ecosystem services, which are the *"ecological processes or functions which have value to individuals or society"*[1]. Examples include flood protection, soil fertility for food production, medicines, carbon storage and water and air filtration. The economy relies on these ecosystem services, which are worth over $150 trillion annually – twice the size of global GDP (Kurth *et al*, 2021). Most ecosystem services are very expensive, if not impossible, to replace with human technology. However, at some level, this kind of quantification is misplaced because if biodiversity were at zero, humans would not exist.

The scale of land-use change and degradation of habitats has accelerated vastly in the past 50 years. While less than 3 percent of all species have been lost completely (Barnosky *et al*, 2011), over 75 percent of species populations have disappeared in the worst-affected habitats (Newbold *et al*, 2015). More species might have disappeared that humans are unable to monitor or count in the oceans and soil. The depletion of nature has reached very dangerous levels for life in the future. One indicator is the planetary boundaries framework, which shows that biosphere degradation is already in the high-risk zone (Richardson *et al*, 2023).

Ecosystem services are either not given a monetary value or are implicitly priced at zero or negatively

Although economic activities depend on ecosystem services that rely on the structure, function and resilience provided by biodiversity, those services are either not given a monetary value or they are implicitly priced at zero or negatively. The cost of nature loss is not borne by those who destroy it, and those who maintain it are little rewarded. The incentive structure for maintaining the value of this asset is therefore perverse. Even worse, there are many incentives for degrading the asset, such as subsidies for nature-harming agricultural practices. The economics of biodiversity are characterised by fundamental problems, most notably that *"our demands far exceed nature's capacity to supply us with the goods and services we all rely on"* (Dasgupta, 2021), but there are few prices or values for nature in the current economic system that would balance supply and demand (Dasgupta, 2021).

Many people want to protect nature for its intrinsic value. Moreover, Europeans have a responsibility for the destruction of biodiversity embedded in value chains that serve European Union markets, much of which takes place outside the EU's borders (UNEP, 2024).

Loss and degradation of nature have local, regional and global effects:

At local level, destruction of plant life can cause soil erosion and water pollution that reduce food production or the loss of ecosystem services such as crop pollination. This can have wider impacts, by reducing food production for export or creating local food insecurity (FAO, 2020).

At regional level, deforestation can disrupt the hydrological cycles that maintain water supply in rivers that cross boundaries, affecting numerous countries. For example, the Congo rainforest is essential to hydrological cycles in sub-Saharan Africa, accounting for 10 percent to 20 percent of agricultural water use in neighbouring countries (Nyasulu *et al*, 2024).

At international level, loss of biodiversity in any part of the world reduces regulation of the climate and provision of clean air and water. Plants absorb and store carbon dioxide. For carbon sequestration, fast-growing trees might absorb more in the short term. However, older, biodiverse habitats are more valuable than new plantations in providing habitats for species

1 Intergovernmental Panel on Climate Change, 'Glossary of Terms', 2018, https://www.ipcc.ch/site/assets/uploads/2018/03/wg2TARannexB.pdf.

that provide other ecosystem services, including biologically diverse ecosystems with complex characteristics that have evolved over long periods. For example, 80 percent[2] of registered medicines come from or have been inspired by plants and natural products, such as the wild plant native to Madagascar that increased the probability of remission of leukaemia in children from 10 percent in 1960 to 95 percent by 1997 (Roberson, 2008).

Those biodiverse ecosystems are also storehouses of future solutions for healthcare and other human needs. The pharmaceutical and life-science industries have a very high level of dependence on nature for research and development. A global agreement in November 2024 on digital sequence information – genetic data – could generate between $1 billion and $9 billion from the profits of companies that use such data to protect currently unknown species that could save human lives in the future[3]. Natural ecosystems contain many unknown future solutions to human problems that evolution has provided in other species or natural cycles, such as cancer treatments, ways of breaking down toxins or ways of adapting to extreme heat and cold.

All of these levels of impact have major economic consequences, some of them systemic (see section 2). A major report by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (the equivalent of the Intergovernmental Panel on Climate Change) found that more than half of global GDP – more than $50 trillion of annual economic activity – is moderately to highly dependent on nature. Unaccounted-for costs of current approaches to economic activity, reflecting impacts on biodiversity, water, health and climate change, including from food production, are at least $10 trillion to $25 trillion per year (IPBES, 2024).

A collapse in ecosystem services such as wild pollination, provision of food from marine fisheries and timber from native forests could result in a decline in global GDP of $2.7 trillion in 2030 (Johnson *et al,* 2021). Pollination services are worth €153 billion a year – affecting almost 10 percent of the global production of food (Khalifa *et al*, 2021) and nearly all of the vegetables and fruit that humans eat. Nature-positive actions can be a high-value investment. For example, the European Commission (2022a) estimates that every euro invested in EU nature restoration brings between €4 to €38 in benefits in public goods such as better health.

However, those who suffer from the destruction of biodiversity (eg local communities) are usually not the same as those who benefit from it (eg agribusinesses). Furthermore, policymakers are often unable to trace damage back to biodiversity loss; the default solution is to invest in grey infrastructure such as dykes or water-filtration systems, rather than nature-based solutions such as wetland restoration or upstream watersheds[4], which can be cheaper and have numerous co-benefits (Bassi *et al*, 2021).

The remaining biodiverse habitats provide a global public good but many lie in Global South countries that lack public funds to protect them

There are distributional shortcomings in the global finance for biodiversity. The remaining biodiverse habitats provide ecosystem services that are a global public good but many lie in Global South countries that lack public funds to protect them adequately or to remediate damage. The need for finance to maintain the value of natural assets is therefore both local and global. However, currently both the quantity and quality of finance for biodiversity is insufficient.

European Commission President Ursula von der Leyen has floated the idea of nature credits as a way for local businesses that depend on ecosystem services such as clean water and pollination to pay local farmers to ensure these services through maintenance of the ecosystems on their land (von der Leyen, 2024). She also mentioned the idea of creating a market for

2 Earlham Institute, 'Hidden biodiversity: a matter of life or death', 14 May 2021, https://www.earlham.ac.uk/articles/hidden-biodiversity-matter-life-or-death.

3 Agreement at the 2024 United Nations Biodiversity Conference in Cali, Colombia. See Luke Taylor, 'A Big, Big Win: Plan to Pay for Wildlife Conservation Emerges at Biodiversity Summit', *Nature*, 4 November 2024, https://www.nature.com/articles/d41586-024-03609-6.

4 John Talberth and Craig Hanson, 'Green vs. Gray Infrastructure: When Nature Is Better than Concrete', WRI Indonesia, 19 February 2018, https://wri-indonesia.org/en/insights/green-vs-gray-infrastructure-when-nature-better-concrete.

these credits, analogous to the carbon credit market under the EU emissions trading scheme.

In its future work on biodiversity certification and nature credits, the EU will need to consider the additionality that private capital could bring. Nature credits could be a way of channelling additional money to protect or restore biodiverse ecosystems, if demand were to grow beyond voluntary approaches, for example because of the introduction of obligations through application of the polluter-pays principle. The nature-positive projects that credits would fund are unlikely to generate significant profits, so the overall capitalisation of private-sector markets for nature credits looks likely to remain small if they remain voluntary. To achieve larger scale funding, the markets would have to be created through regulation.

This policy brief examines these issues and provides examples the EU should consider in developing financially rewarding measures that restore and preserve natural capital assets. The focus in developing existing and new tools should be on whether they can deliver reliable revenue streams over a long period to maintain the value of natural assets. In the EU, the most impactful immediate means of using financing to protect and restore nature would be to defund the damage caused to biodiversity by eliminating nature-harming subsidies, starting with reform of the common agricultural policy.

2 Why is finance for nature inadequate?

The links between nature and the economy have long been ignored, with environmental impact treated as an externality that is not measured or accounted for in economic systems. Over the past decades, understanding of the economic impact of climate change has spread, and international cooperation under the United Nations has resulted in a focus on one principal target (stabilising temperature rise) and one major measure (reducing emissions of greenhouse gases). Global warming is now widely accepted in both the public and private sectors – and in the financial sector (Carney, 2015) – as a problem for the global commons that needs collective action.

There is even a lack of unified definitions of nature and biodiversity for estimating financing needs

This is not the case for nature loss. There is even a lack of unified definitions of nature and biodiversity for estimating financing needs. As explained by Dasgupta (2021), biodiversity loss is inherently harder to measure than climate-change impacts because it is complex, nonfungible, silent and invisible, meaning no single measure or target can capture all aspects of biodiversity loss. The UN Biodiversity Conference of Parties (COP) adopted at the COP15 summit in 2022 the Kunming-Montreal Global Biodiversity Framework (GBF), which calls for countries to halt and reverse biodiversity loss by 2030 and to raise an additional $700 billion per year to do so. This additional funding goal is to cover the elimination, phase-out and reform of at least $500 billion per year in subsidies harmful to biodiversity, and the mobilisation of $200 billion through all sources including official development assistance, private finance and innovative schemes including payment for ecosystem services, green bonds, biodiversity offsets and credits[5].

The 2024 UN biodiversity summit (COP16) in Cali, Colombia, demonstrated momentum behind the implementation of the GBF, with 44 economies (including the EU) submitting revised National Biodiversity Strategy and Action Plans (NBSAPs) and 119 countries issuing revised national targets aligned with this framework. COP16 adopted other decisions to support implementation, including a decision to establish the 'Cali Fund' for sharing the benefits from the utilisation of digital sequence information on genetic resources (see footnote 3).

This agreement requires companies that benefit from the genetic resources that biodiversity provides, such as manufacturers of pharmaceuticals or cosmetic products, will pay 1 percent of their profits, or 0.1 percent of their revenues, into a fund that will support conservation

5 See Convention on Biological Diversity, 2030 Targets, available at https://www.cbd.int/gbf/targets.

and sustainable use of biodiversity. At least half of the fund is intended to benefit indigenous communities that protect intact habitats[6]. However, the amount of finance that this new tool will raise in practice remains uncertain, as not all countries with relevant industries have committed to make it mandatory.

The Cali biodiversity summit, however, failed to reach agreement on resource mobilisation. Establishment of a new biodiversity fund to help poorer nations restore their depleted natural environments was blocked by developed economies, including the EU, Japan and Canada. Pledges to the GBF Fund almost doubled, but reached only $396 million[7].

For the EU, the European Commission's latest Environmental Implementation Review (EIR) (European Commission, 2022b) calculated additional investment needs (over current expenditure levels, ie the financing gap) for the implementation of the EU biodiversity strategy for 2030 to be €21.5 billion a year to 2027. These additional investments should focus on protection, restoration and sustainable-use measures for species, habitats and other ecosystems, and on enabling implementation, including mainstreaming biodiversity in business decision-making, and any other aspects covered in the EU biodiversity strategy for 2030 (European Commission, 2021a).

The EU budget will play an important role in meeting these investment needs but much of the needed funding is expected to come from EU countries' national budgets and from private finance. The EIR also estimated the additional investment needs for the implementation of pollution prevention and control policies, and for water protection, management and industries, at €69.4 billion per year from 2021 to 2027. Such investments are also expected to have positive spillovers on biodiversity in the EU, notably by reducing direct pressures on nature.

The biodiversity gap estimate cited in the 2022 EIR report was based largely on a study (Nesbit *et al*, 2022) that estimated additional investments of €18.7 billion per year from 2021 to 2030 to meet 41 objectives in the EU 2030 biodiversity strategy. The largest estimated financing needs for biodiversity are linked to the legally binding targets set in the EU Nature Restoration Law (Regulation (EU) 2024/1991) that entered into force in August 2024, followed by measures to halve the number of species threatened by invasive alien species, and the creation and integration of ecological corridors.

There are two main reasons for the global financing gap for nature:

1. Common resource problem: The incentives for the preservation and restoration of biodiversity are dwarfed by the scale of incentives for activities that damage nature. Many of those who benefit from ecosystem services do not pay, while most of those who destroy nature earn a profit. This means that the common resource is overused. There has been much less progress on nature than on climate in finding targets, measures and commitment devices.
2. Ignorance of value and risks: Many stakeholders are unaware of the importance of maintaining healthy ecosystems in order to continue benefitting from the services they provide, so biodiversity is little valued. The economic consequences of nature degradation are not widely understood, including the systemic risks. The scale of incentives for human activity that destroys biodiversity remains so large because the risks of nature loss are not accounted for in public or private finance.

The economic costs of losing nature are very large and should not only be paid by the public sector when private actors profit from ecosystem services. However, mobilising private finance is also difficult (Table 1).

6 See Convention on Biological Diversity, 'Digital sequence information on genetic resources', available at https://www.cbd.int/doc/c/bd4f/2861/9dce4f46d43a637231a442e0/cop-16-l-32-rev1-en.pdf.

7 The Nature Conservancy, 'COP16: What happened at the 2024 UN biodiversity Conference', 5 November 2024, https://www.nature.org/en-us/what-we-do/our-priorities/protect-water-and-land/land-and-water-stories/biodiversity-global-conference/.

Table 1: A categorisation of challenges to private finance in biodiversity

Challenge	Description
No cashflow	Biodiversity and ecosystem services are public goods, the values of which are not reflected in economic transactions, which means that they frequently involve no cashflow.
Scale and localised nature of biodiversity projects	Small and local biodiversity projects must be aggregated to attract large-scale finance.
Paucity of data, measurement and standards	Biodiversity is complex and there is no single metric; metrics accounting for the impact of operations and supply chain on biodiversity are limited; lack of clear taxonomy or widely accepted risk assessment/reporting framework. There is also no requirement to do this kind of reporting.
Perverse economic incentives	Subsidies to economic activity harmful to biodiversity dwarf conservation, restoration and sustainable use of nature.

Source: Bruegel, adapted from World Bank (2020).

3 Overview of tools to improve the quantity and quality of nature finance

Financial tools for nature can be thought about in two ways: mechanisms that green finance and mechanisms that finance green. Greening finance is about integrating nature considerations into the financial system. This could include incorporating biodiversity risk into decision-making, or natural capital accounting that assigns a value to ecosystems. Financing green is about investing in nature, for protection or restoration of the intactness of ecosystems. This could include payments for ecosystem services, green bonds or biodiversity credits. So far, the field of 'sustainable finance' has mainly focused on climate, not nature.

There is clearly a crossover between the two. For example, if a bank incorporates a risk approach to biodiversity when making decisions about its portfolio investments, then funding to nature-positive investments might increase because the cost of capital for nature-damaging activities would be higher to reflect the greater risk inherent in them (recognising the double materiality that the economic activity causes nature loss while nature loss then threatens the economy).

3.1 Greening finance: the risk approach

The degradation of natural assets poses a systemic risk to the financial sector because the economy as a whole and individual businesses depend on the ecosystem services that nature provides. Climate and biodiversity are interlinked because climate change damages ecosystems (through drought, flood, fires) and natural ecosystems are needed to keep the climate stable – for example by absorbing and storing greenhouse gases, and by providing shade that reduces temperatures. Moreover, nature-based solutions are often cost-efficient solutions for reducing climate risks. The incorporation of climate risks into financial stability mandates therefore means the inclusion of some biodiversity risks.

Box 1: Measuring and valuing biodiversity

Introducing financial tools into biodiversity implies measuring and valuing biodiversity. There is a broad spectrum of approaches to this. Some tools might rely on rigorous measurement, such as measuring increases in species populations in a specified area to assess the outcome of a biodiversity credit. Another approach is to measure the economic value derived from biodiversity – attempting to quantify the services that biodiversity provides, such as pollination, and how much it would cost to replace them. This is not necessarily underpinned by exact calculations of species numbers or habitat condition.

Measuring biodiversity *per se* is complex and there is no one correct way to do it. While over 570 metrics have been proposed so far, there is no agreed international standard (Antonelli *et al*, 2024). Unlike carbon emissions, biodiversity is not evenly distributed. This means that biodiversity must be assessed locally, although its disappearance can have much wider implications (see section 1). Furthermore, biodiversity contains a diverse range of things, from the genetic diversity in a single population to the variety of ecosystems across the globe[8].

The complexity of biodiversity means that its value can vary according to the species population, ecosystem, geographical and cultural context (Antonelli *et al*, 2024). There are several frameworks for thinking about the ways in which changes to biodiversity might be measured. For example, the UK government (DEFRA, 2023) defines four metrics:

1. Gains or losses in the variety and abundance of, or within, species (for example, because of changes to wildlife control and management, changes to farmland management, or any land use change);
2. Gains or losses in the amount of space for ecosystems and habitats (for example, because of building development, or changes in land use);
3. Gains or losses in the physical connectedness between ecosystems and habitats (for example, because of transport developments);
4. Environmental changes within ecosystems and habitats (for example, arising from changes in any type of pollution, restrictions of water supply, climate change, invasive alien species).

The UN has a statistical framework for organising data about habitats and landscapes, rather than biodiversity *per se*. The UN SEEA Ecosystem Accounting (SEEA EA) measures ecosystem services, tracks changes in ecosystem assets and links this information to economic activity[9].

Other tools, such as the natural-capital approach, rely on quantifying the economic value of the welfare effects of biodiversity. This can be thought of as the use value (eg timber, recreation, carbon storage), option value (future and perhaps unknown uses) and non-use value (inherent value or cultural value) (Moran and Bann, 2000).

Financial regulators, particularly central banks, are beginning to create frameworks and tools to address climate risks, but work on nature-related risks is less advanced. There is a lively debate about how far central banks should go to address climate and nature as part of their primary mandate of price stability, and how to address these risks building up in the financial system. Recent analysis and policy recommendations have addressed ways to green the European Central Bank (Bosch, 2023) and how central banks should bring climate into their mandates (Claeys *et al*, 2024). Climate and nature are important to the mandates of

8 Center for Biological Diversity, 'The Elements of Biodiversity', undated, https://www.biologicaldiversity.org/programs/biodiversity/elements_of_biodiversity/.

9 See United Nations, 'SEEA Ecosystem Accounting', undated, https://seea.un.org/ecosystem-accounting.

central banks in several ways, including their impact on price stability and monetary policy transmission (Schnabel, 2023), and on the stability of the financial sector because of loans to businesses that depend on ecosystem services (Elderson, 2024).

The European Commission (Cziesielski *et al*, 2024), European Central Bank and Dutch and French national banks are among the institutions starting to calculate how exposed their portfolios are to nature risk. The ECB found that 75 percent of all corporate loan exposures in the euro area have a strong dependency on at least one ecosystem service, such as clean water (Boldrini *et al*, 2023). The French and Dutch central banks have calculated exposure to biodiversity risks of €510 billion and 42 percent of the value of their securities portfolios, respectively (van Toor *et al*, 2020; Svartzman *et al*, 2021).

However, approaches so far have focused mainly on mitigating the risks of climate-related damage to the value of assets under their macro- and micro-prudential responsibilities, rather than preventing further climate change by incentivising investment in the green transition and finding ways of putting a positive value on nature. Work on incorporating biodiversity risks into mainstream disclosure and risk mitigation strategies is advancing at the ECB, in the Network for Greening the Financial System and in the Taskforce on Nature-related Financial Disclosures.

One of the ECB's recommendations is to move beyond the risk-focused approach and account for the value of natural capital. When ecosystem services are valued, the opportunity cost of degrading the habitats that provide them increases. The ECB is also starting to measure the contribution of the financial sector to the degradation of natural assets, having calculated an impact on biodiversity loss in the euro area of €4.3 trillion in corporate loans (Ceglar *et al*, 2023).

Many central banks follow a market-neutral approach to avoid market distortions, which means that they purchase a proportion of available corporate bonds on the market, regardless of their carbon intensity (Schoenmaker, 2019). Some central banks are starting to incorporate climate considerations into monetary policy. For example, the ECB in 2021 presented an action plan to include climate change considerations in its monetary policy strategy[10]. This was significant in shifting from the market neutrality principle (Bosch, 2023). In the private sector, credit ratings agencies and insurers are developing their own methodologies.

This attention to environmental and climate risks in the financial system is an important step in recognising and analysing previously uncalculated risks. However, financial regulators and private credit agencies cannot introduce the policies and laws that would reduce these risks. Governments and international institutions have to design policies to reduce the risks and approve standards and methods for valuing natural capital.

3.2 Greening finance: the value approach of natural capital accounting

Assigning value to biodiversity is important because it puts biodiversity on a level with the drivers of habitat and species loss (Moran and Bann, 2000). Valued natural capital can contribute to decisions about changes in land use – for example, planning permission for construction projects – by determining damages for loss of biodiversity, choosing economic instruments for saving biodiversity and bringing in long-term consequences (OECD, 2002).

A way of assigning this value is through natural capital accounting, defined as *"compiling consistent, comparable and regularly produced data using an accounting approach on natural capital and the flow of services generated in physical and monetary terms to show the contribution of the environment to the economy and the impact of the economy on the environment"* (Lok *et al*, 2018).

Natural capital accounting frameworks provide a standardised framework for identification, measurement and valuation of impacts and dependencies on natural capital (Natural

10 European Central Bank press release of 8 July 2021, 'ECB presents action plan to include climate change considerations in its monetary policy strategy', https://www.ecb.europa.eu/press/pr/date/2021/html/ecb.pr210708_1~f104919225.en.html.

Capital Coalition, 2021). This makes nature visible on balance sheets and means it can be factored in when balancing trade-offs, such as whether to build roads through a forest or to clear mangroves to build a port[11].

However, decision-makers in firms and governments have frequently ignored natural capital. For example, calculations of economic growth ignore natural capital, and might over-estimate growth in countries that rely on resource depletion to generate this growth (OECD, 2017). Yet, on its own and in conjunction with other capital, natural capital produces a wide array of benefits, both in use value and non-use value (HM Treasury, 2022).

Table 2 summarises the main economic valuation techniques used in natural capital accounting. Setting of high-quality accounting standards would ensure that natural capital is treated in the same way as physical and human capital.

Table 2: Overview of economic valuation techniques used in natural capital accounting

Category	Method	Description
Revealed preference and market-based methods	Market prices	The market price of traded goods, corrected for market distortions such as subsidies eg timber, cost of renting arable farmland.
	Impact on productivity	Considering the changes in production processes that result from an environmental change eg contribution of pollinators to agricultural production.
	Hedonic pricing	Extracting the contribution of environmental characteristics to the price of a good or service, eg higher property prices near parks.
	Travel cost	Costs incurred by individuals taking a trip to a recreation site as a proxy for its value eg entry fees, travel costs.
	Cost of illness, human capital	Trace the impact of a change in ecosystem services on morbidity and mortality.
Stated preference methods	Contingent valuation (CV)	Ask respondents directly their willingness to pay for a particular environmental change or service, eg surveys.
	Choice modelling	Individuals are asked to choose their preferred option from a set of alternatives, or to rank alternative combinations, ie like CV but minimises biases.
Cost-based approach	Damage costs method	In the absence of an ecosystem service, what would be the cost of damage, eg damage to infrastructure from floods, cost of illness? May provide an upper bound of what individuals are willing to pay for an ecosystem service.
	Replacement cost method	Considers the cost of providing a substitute good or engineering solution that performs a service provided by nature, eg cost of man-made flood defences as a proxy for the value of wetlands.
	Opportunity cost method	Considers the value forgone to protect, enhance or create a particular environmental asset, eg opportunity cost of lost agricultural production if land retained as forest.
	Restoration cost method	The cost of restoring a service provided by nature to a state similar to its original state.

Source: Bruegel based on DEFRA (2023), Daly Hassen (2016), Convention on Biological Diversity (https://www.cbd.int/doc/publications/cbd-2007-poster-en.pdf).

11 See World Bank, 'Natural Capital', 25 October 2024, https://www.worldbank.org/en/topic/natural-capital.

3.3 Financing green: an overview of tools

Several tools exist which can direct finance to protecting, restoring and monitoring biodiversity. Fees have been used for many years, including entrance fees to national parks, and hunting and fishing licenses (OECD, 2024). Philanthropy also helps, with around €87 million in biodiversity-relevant funding contributed by private foundations in 2018 in the EU (Nesbit *et al*, 2022). Global corporate philanthropy totalled $71 billion in 2022, accounting for 11 percent of global philanthropy (WEF, 2024), but less than 5 percent of corporate philanthropy is deployed to climate and nature – $607 million in 2022.

The amounts raised through fees and philanthropy are very small relative to the financing needs. In the subsequent sub-sections, we describe tools that would channel additional finance to nature from both the private sector (biodiversity credits and offsets, payments for ecosystem services, green bonds) and the public sector (debt for nature swaps, fiscal incentives). Many new tools are at an early stage of development, which is why it is essential for the public sector to ensure that their integrity is high. Otherwise, they will not scale up financial flows and bring real benefits to nature.

3.3.1 Biodiversity credits and offsets

A biodiversity credit *"represents a measured and evidence-based unit of positive biodiversity outcome that is durable and additional to what would have otherwise occurred"* (BCA, 2024). A biodiversity credit can be purchased by a company or an individual who wishes voluntarily to restore nature or protect intact ecosystems, and can certify their contribution to nature conservation.

Some schemes use biodiversity credits to offset unavoidable negative biodiversity impacts from an economic activity and thereby to achieve no net loss in biodiversity (OECD, 2024). An example is the UK government's Biodiversity Net Gain law for planning permission, which will also allow trading of credits[12]. However, unlike carbon credits, the lack of a common metric makes biodiversity credits difficult to trade and use as offsets (Box 1). Since biodiversity is more complex and locally specific than carbon, the framework proposed by the International Advisory Panel on Biodiversity Credits for high-integrity biodiversity credits has narrow criteria for what can work (IAPB, 2024). For example, it rejects international offsetting approaches, in favour of local and like-for-like compensation. Wunder *et al* (2024) discussed results- or performance-based credits as another way to ensure integrity. Furthermore, it can take much longer for the benefits of nature credit schemes to materialise than with carbon credits, given that nature is a long-term investment (Antonelli *et al*, 2024).

Unlike carbon credits that are now mainstream, biodiversity credits are less well known and understood, and less sought after

Unlike carbon credits that are now mainstream, biodiversity credits are less well known and understood, and less sought after. The OECD estimated that by 2024 there were 17 active biodiversity offset programmes in nine countries (OECD, 2024). Wunder (2024) estimated that there are 34 biodiversity credit schemes globally, ranging from in-development to fully operational. For example, the World Economic Forum estimates the total size of biodiversity credit markets at $8 million, but believes that global demand for voluntary biodiversity credits could reach $69 billion by 2050 (WEF and McKinsey, 2023).

The potential for nature or biodiversity credits to bring in significant new private finance depends on how they are designed and used. If they are a means of payment for ecosystem services, they could be useful in establishing a reliable incentive structure for landowners to maintain biodiversity.

However, much work is still to be done on how to make such a market work and for it to generate new finance flows. The amount of finance that credits could mobilise would depend on buyers being willing to pay for the cost of these public goods, which means either public bodies buy them directly or they require private actors to purchase them, as in the case of the emissions trading scheme for carbon credits. In the EU, another use of nature credits could be

12 See UK Government, 'Guidance: Biodiversity net gain', 1 May 2024, https://www.gov.uk/guidance/biodiversity-net-gain.

as an alternative means of payment to farmers, foresters and land managers of subsidies that benefit the environment, instead of being based on production or farm size.

Quality also matters if nature credits are to provide reliable sources of long-term finance. Establishing a market for trading nature credits would require the design of a system that avoids the pitfalls encountered in voluntary carbon credit markets, such as double-counting, fraud, low integrity and low quality[13], as well as leakage (when a credit shifts harmful activities to non-protected areas). To ensure the quality of nature credits, some kind of independent body would be needed to overcome problems such as a conflict of interest between private auditors, the project developers who paid them and the private certification bodies that issued the credits (Marion *et al*, 2024).

Moreover, a plethora of standards is already emerging in the large number of different schemes, despite the low level of overall finance that they have mobilised. For biodiversity credits to be credible sources of long-term finance for high quality nature protection and restoration, high integrity standards must be a priority.

3.3.2 Payments for ecosystem services (PES)

Payments for ecosystem services put a price on the unpaid caring for nature done by owners and local communities, such as keeping trees standing to sequester carbon or using sustainable agricultural techniques that protect pollinators. Payments are made by those who benefit from the services to those who are responsible for preserving the ecosystems that provide those services. For example, a water utility might pay upstream land managers to take measures that preserve or improve water quality, or developed countries might pay developing countries to preserve forests (Fripp, 2014). This is based on the principle that the beneficiary pays, rather than that the polluter pays (Engel *et al,* 2008; Wunder *et al,* 2020).

For example, in Costa Rica, landowners receive payments when they apply sustainable land-use and forest-management techniques (Sanchez-Azofeifa *et al,* 2007). Funding is through several channels, notably Costa Rica's fuel tax and water charge.

As of 2024, there were 51 PES schemes in 28 countries (OECD, 2024). Such schemes require a willingness to pay for the service, institutions that coordinate actions and property rights (Wunder and Mauri, 2023). So far, this instrument had not yielded much finance, but the Cali Fund (see section 2) could reap large revenues if well implemented.

3.3.3 Green bonds

Green bonds for biodiversity are standard bonds with the additional feature that part of the proceeds go to projects that generate benefits for biodiversity[14].

Bonds for climate action have traditionally dominated the green bonds area. According to Fitch (2023), while 5 percent of labelled bonds issued in 2020 featured biodiversity conservation as a use of proceeds, this rose to 16 percent in 2023. Lower awareness in the financial sector about biodiversity relative to climate and fewer standardised metrics are barriers to green bonds for biodiversity.

The World Bank in 2022 issued a 'Rhino Bond', a five-year $150 million results-based bond intended to contribute to protecting black rhino populations in South Africa[15]. Issued to foster institutional investor engagement, the bond funds national parks and unlocks a return that is distributed to bondholders after five years if there is an increase in the rhino population. The return is funded by the Global Environment Facility, a multilateral fund financed by donor countries.

13 See, for example, Matt Levine, 'Some of the Carbon Credits Were Fake', *Bloomberg*, 8 October 2024, https://www.bloomberg.com/opinion/articles/2024-10-08/some-of-the-carbon-credits-were-fake.

14 Jyotsna Puri, 'Show me the money: recent actions in biodiversity financing', *Global dev*, 9 April 2024, https://globaldev.blog/show-me-the-money-recent-actions-in-biodiversity-financing/.

15 World Bank press release of 23 March 2022, 'Wildlife Conservation Bond Boosts South Africa's Efforts to Protect Black Rhinos and Support Local Communities', https://www.worldbank.org/en/news/press-release/2022/03/23/wildlife-conservation-bond-boosts-south-africa-s-efforts-to-protect-black-rhinos-and-support-local-communities.

3.3.4 Debt-for-nature swaps

A debt-for-nature swap occurs when a third party (usually an international conservation organisation) purchases an indebted, biodiversity-rich country's foreign debt at a discounted rate. The country commits to repaying this debt to the third party, usually in local currency, and commits to funding nature protection with the difference between the original value of the debt and the discounted value.

Debt-for-nature swaps first emerged during the debt crises of the 1980s. The first debt-for-nature swap was in 1987 between Bolivia, Conservation International, Citicorp and USAID (World Bank, 1993). Since 1987, there have been 145 recorded debt-for-nature swaps according to the African Development Bank, amounting to $3.7 billion in debt (African Development Bank, 2022).

Debt-for-nature swaps rely on the willingness of commercial banks, governments or other debt holders to sell less than the full value of the original loan. Critics point out that indebted countries may lose autonomy over land, are too small to solve the debt or biodiversity problems, and the swaps often have high transaction costs[16].

3.3.5 Fiscal incentives

Fiscal incentives rely on the volition of governments rather than private individuals or companies. They are the main source of finance for biodiversity because they do not require a profit motivation and can deliver public goods.

Taxes can be based on the polluter pays principle. Biodiversity-positive taxes can include those on pesticides, fertilisers or timber, if they are based on the environmental damage caused. On average from 2020 to 2022, OECD countries generated $9.96 billion in biodiversity-positive taxes (OECD, 2024). However, this constituted 1.3 percent of all environmental tax revenue.

Governments can also use subsidies to finance biodiversity protection. According to the OECD, there are 240 biodiversity positive subsidies in force across 34 countries (OECD, 2024). However, annual government expenditures on agricultural, forestry and fishery subsidies that are harmful to biodiversity were two to four times higher than total annual capital flows going to biodiversity conservation (Deutz *et al*, 2020). Elimination of subsidies that encourage harm to nature would be more productive.

4 The EU's role in nature finance

The EU has characteristics that make it especially important in solving the collective-action problem of financing biodiversity. It is a regional governance system with regulatory powers and financing for public goods over long time horizons, and also an international actor that provides finance for global public goods. The EU could directly implement some of the tools outlined above through its common policies and budget, while encouraging the private sector to apply others. However, more than 80 percent of the EU's own natural habitats are in poor condition[17]. Before developing new approaches, the EU should evaluate the structure of incentives already created by its common policies, budget and regulation of the financial sector. In particular, the EU could do much more to phase out harmful subsidies.

16 Aruna Chandrasekhar and Yanine Quiroz, 'Q&A: Can debt-for-nature "swaps" help tackle biodiversity loss and climate change?' *Carbon Brief*, 16 July 2024, https://www.carbonbrief.org/qa-can-debt-for-nature-swaps-help-tackle-biodiversity-loss-and-climate-change/.

17 European Environment Agency, 'Habitats and species: latest status and trends', 4 April 2023, https://www.eea.europa.eu/en/topics/at-a-glance/nature/state-of-nature-in-europe-a-health-check/habitats-and-species-latest-status-and-trends.

Positive EU funding of biodiversity is outweighed by harmful subsidies, which could be considered a form of negative financing of nature

Through its common budget, the EU has long contributed to biodiversity. Over the 2021-27 period, the EU budget's contribution to biodiversity is estimated at €112 billion, or 6.5 percent of the EU budget[18]. The common agricultural policy (CAP), Cohesion Policy funds and Recovery and Resilience Strategy account for 57 percent, 14 percent and 11 percent of EU budget contributions to biodiversity, respectively[19].

However, positive EU funding of biodiversity is outweighed by harmful subsidies, which could be considered a form of negative financing of nature. EU subsidies that harm biodiversity are estimated to range from €34 billion to €49 billion per year (WWF, 2024), including at least 60 percent of the subsidies paid under the CAP and national agriculture- and forestry-related subsidies. Numerous public incentives encourage over-exploitation of natural resources, reducing the natural functions of agricultural habitats and fragmenting habitats (Auverlot *et al,* 2011).

The EU's Eighth Environmental Action Programme called for the identification, reporting and phase out of environmentally harmful subsidies, beyond fossil fuel subsidies. The European Commission has assembled a member-state expert group to work on this[20] and has also issued guidance on reforming harmful subsidies in Europe (European Commission, 2022c).

In 2020, the EU adopted the Biodiversity Strategy for 2030. The strategy's goal is to foster the recovery of biodiversity, protect natural areas and restore degraded ecosystems in the EU by 2030. The strategy called for legally binding targets for biodiversity for the first time. Key elements of the strategy include the Nature Restoration Law, Forest Monitoring Framework and Soil Health Law, but only the Nature Restoration Law has so far been passed.

The strategy also aimed to mobilise €20 billion a year through both national and private funding to achieve EU biodiversity targets. However, a subsequent study estimated these needs at €48 billion annually from 2021 to 2030 (Nesbit *et al*, 2022). These are aspirational targets rather than legally binding ones, unlike the EU's climate targets.

The Commission has in the past developed several new methods of public finance for biodiversity. The Natural Capital Financing Facility (NCFF) was a financial instrument set up to provide loans and investments in projects that promote the conservation of natural capital within the EU (European Commission, 2016). It blended European Investment Bank financing with European Commission funding. The biodiversity strategy also called for a dedicated natural-capital initiative to mobilise €10 billion, based on blended finance, but this has yet to materialise.

However, the EU's approach has been criticised since it predominantly integrated biodiversity funding into broader funding streams, meaning that this objective has to compete for resources with other sectors that have specific lobbies and enjoy stronger political backing because they generate profits (Strategic Dialogue, 2024[21]). The European Investment Bank (EIB, 2023) also concluded that major lessons from the NCFF included issues of small deal size and complexity, high administrative costs and uncertainty of cashflow. The European Commission's 2022 initiative 'Green Assist' to help beneficiaries prepare greener investment projects was a positive development to overcome some of these problems[22].

18 See European Commission, 'Budget contribution – biodiversity (commitments; million EUR)', undated, https://commission.europa.eu/document/download/83ae884a-db42-4423-aca0-3cf8dfb0e02d_en?filename=Budget%20contribution%20-%20biodiversity.pdf.

19 All EU funding instruments relevant for biodiversity are detailed in European Commission (2024).

20 See Article 3(h) of Decision (EU) 2022/591, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32022D0591.

21 See also joint statement of 9 July 2024 by Euronatur and other NGOs, 'Unlocking funds for nature: How the next EU budget must deliver for biodiversity', https://bankwatch.org/wp-content/uploads/2024/07/2024_07_Unlocking-funds-for-nature_How-the-next-EU-budget-must-deliver-for-biodiversity.pdf.

22 European Commission, 'Green Assist: the Green Advisory Service for Sustainable Investments Support', undated, https://cinea.ec.europa.eu/programmes/life/green-assist-green-advisory-service-sustainable-investments-support_en.

The Commission has conceded that biodiversity is an area of public finance with a relatively low absorption rate and level of execution of projects (European Commission, 2024). This is related to lack of capacity, expertise and experience at member-state level, and to lack of political will for conservation measures[23].

Moreover, the methodology for tracking EU biodiversity spending measures investments as either contributing 'principally' or 'significantly', or as 'not targeted', to biodiversity objectives. For tracking purposes, these are counted as 100 percent, 40 percent and 0 percent of the investment respectively (Thomson, 2024). This framework is applied differently in the CAP and in cohesion policy, and results in substantial overestimation of expenditure on biodiversity and its positive impact, with no regard for the results achieved (Thomson, 2024; ECA, 2024). The European Court of Auditors has recommended that the EU should move to a more results-based tracking methodology, and should improve data collection and introduce more measurable objectives (ECA, 2024).

An example of this is the 2021 Recovery and Resilience Facility, intended to boost the EU economy after the COVID-19 pandemic. The RRF required each EU country to allocate 37 percent of the RRF funding it received to *"the green transition, including biodiversity"* (European Commission, 2021b). However, almost no allocations to biodiversity have been made. One reason for low public funding in the EU could be that the do-no-significant-harm assessments (European Commission, 2023), normally required by EU regulation, were not carried out as intended, degrading the only safeguard in place for RRF funds (Bozekova *et al*, 2021). There was also no binding obligation for member states to use RRF funding for biodiversity.

A further EU role is setting the regulatory framework for sustainable finance that also applies to nature-positive finance. The EU's regulatory tools, such as the taxonomy of green investments and disclosure requirements, could be used more effectively, and the EU should develop a coherent framework for transition finance (Merler, 2025).

4.1 How the EU should consider new approaches

In considering new approaches to increase public and private financing of nature restoration and protection, a number of issues need to be considered:

- International political economy: Will the proposed approach garner support in all countries? Will it survive in other countries even if there is political backlash in one country?
- Additionality: How much additional finance will the approach bring? Will it set standards or ensure reliable commitments by public and private players?
- Permanence: Will the proposed approach retain support over the time period needed to achieve climate and environment targets? For example, will a forest protection measure ensure continued carbon sequestration until 2050 and beyond? Will the approach encourage new monoculture plantations that are more vulnerable than mature, biodiverse forests are to climate change, pests and diseases?
- Sustainability without policy support: Is there a reason for business and other groups to continue funding even if state intervention ceases, ie promising measures is not just about reputation but important for business models?
- Levels of effect: Are the services that an ecosystem provides local or international? Are they systemically important because they reduce risks for the economy?

23 Bankwatch and Euronatur, 'Biodiversity on the brink: what's holding back financing for nature?' *Bankwatch Network Blog*, 5 October 2022, https://bankwatch.org/blog/biodiversity-on-the-brink-what-s-holding-back-financing-for-nature.

5 Conclusions

Better policies to protect biodiversity can be implemented and should be pursued at several different levels. The public sector should better identify and then reduce subsidies to nature-harmful activities, while better assessing and integrating nature risk considerations into public funding decisions. There is an important role for regulators, including the EU, in creating market signals such as pricing that reflect the economic costs of nature loss, now and for future generations.

For the private financial sector, the focus should be on reducing nature-harmful investments and lending, in order to encourage nature-harmful companies to adopt and implement nature-positive transition plans, and to mainstream nature risk assessments and mitigation measures.

Risk managers in both the public and private sectors are starting to incorporate climate risks into their models and regulatory frameworks, even if cascading and interlinked risks are not yet adequately covered. Now biodiversity risk needs to be integrated into risk management as well, as the huge economic implications of loss of ecosystem services become more calculable. Hence it is important to work on prudential supervision of the banking and insurance sectors to start accounting for hidden risks across the economy, and to find ways of quantifying the value of the eco-services that nature provides to economic actors.

Both the greening of finance and the financing of green are needed

Both the greening of finance and the financing of green are needed. As the EU considers new financial tools, it must ensure that they bring sustained finance to preserve biodiversity for future generations. Tools need to elicit both demand and supply, ie they should overcome the common resources problems that prevent sufficient funding to protect natural capital and to maintain its value as a public good.

One way forward could be for the EU to create a robust biodiversity credits framework that helps to channel private-sector finance from those that benefit from ecosystem services to the landowners or stewards who have applied government-certified nature restoration and maintenance measures, demonstrated via biodiversity certificates/credits. A regulatory framework will be needed because profit-based financial tools are unlikely to provide long-term funding for an intact habitat that maintains biodiversity but generates little or no revenues.

In considering the role that nature credits could play, their added value should be assessed relative to the significant EU common policies and common budget that are already providing regulation and public funding. A new credits scheme should not become a distraction from the major nature-positive changes that could be made by removing subsidies that are harmful to nature (especially in agriculture, which is a policy made at EU level) and by using public money at EU and national levels more effectively for biodiversity.

References

African Development Bank (2022) *Debt-for-Nature-Swaps: Feasibility and Policy Significance in Africa's Natural Resources Sector*, available at https://www.greenpolicyplatform.org/sites/default/files/downloads/resource/debt-for-nature-swaps.pdf

Antonelli, A., X. Rueda, R. Calcagno and P. Nantongo Kalunda (2024) 'How biodiversity credits could help to conserve and restore nature', *Nature* 634(8036): 1045–49, available at https://doi.org/10.1038/d41586-024-03475-2

Auverlot, D., G. de Sainteny and J. Pujol (2011) *Public Subsidies Harmful to Biodiversity*, France Stratégie, available at https://www.strategie.gouv.fr/english-articles/report-public-subsidies-harmful-biodiversity

Barnosky, A., N. Matzke, S. Tomiya, G. Wogan, B. Swartz, T.B. Quental ... E.A. Ferrer (2011) 'Has the Earth's sixth mass extinction already arrived?' *Nature* 471(7336): 51–57, available at https://doi.org/10.1038/nature09678

Bassi, A., R. Bechaud, L. Casier and E. Cutler (2021) *How Can Investment in Nature Close the Infrastructure Gap?* Nature-Based Infrastructure Global Resource Centre, International Institute for Sustainable Development, available at https://nbi.iisd.org/wp-content/uploads/2021/10/investment-in-nature-close-infrastructure-gap.pdf

BCA (2024) 'Definition of a Biodiversity Credit', *Issue Paper* No. 3, Biodiversity Credit Alliance available at https://www.biodiversitycreditalliance.org/wp-content/uploads/2024/05/Definition-of-a-Biodiversity-Credit-Rev-220524.pdf

Boldrini, S., A. Ceglar, C. Lelli, L. Parisi and I. Heemskerk (2023) 'Living in a World of Disappearing Nature: Physical Risk and the Implications for Financial Stability', *ECB Occasional Paper* 2023/333, European Central Bank, available at https://doi.org/10.2139/ssrn.4630721.

Bosch, J. S. (2023) *A roadmap towards greening the European Central Bank*, Heinrich-Boll-Stiftung, available at https://eu.boell.org/sites/default/files/2024-01/greening_ecb_web.pdf

Bozekova, E., F. Canali, T. Freisinger, P. Höfferle, J. Kuld, A. Lesage ... Z. Ujj (2021) *Building Back Biodiversity: How EU Member States fail to spend the recovery fund for nature*, Bankwatch Network and Euronatur, available at https://bankwatch.org/wp-content/uploads/2021/05/2021-05-19_Building_Back_Biodiversity_final.pdf

Carney, M. (2015) 'Breaking the tragedy of the horizon – climate change and financial stability', speech given at Lloyd's of London, 29 September, available at https://www.bankofengland.co.uk/speech/2015/breaking-the-tragedy-of-the-horizon-climate-change-and-financial-stability

Claeys, G., M. Le Mouel, S. Tagliapietra, G. Wolff and G. Zachmann (2024) *The Macroeconomics of Decarbonisation*, Cambridge University Press

Ceglar, A., S. Boldrini, C. Lelli, L. Parisi and I. Heemskerk (2023) 'The Impact of the Euro Area Economy and Banks on Biodiversity', *ECB Occasional Paper* 2023/335, European Central Bank, available at https://doi.org/10.2139/ssrn.4651049

Cziesielski, M., C. Dekker-Hufler, T. Pal, G. Nicholls, F. Petsinaris, L. Korteweg, M. Obersteiner and N. Khabarov (2024) *Study for a methodological framework and assessment of potential financial risks associated with biodiversity loss and ecosystem degradation – Final report*, European Commission Directorate-General for Financial Stability, Financial Services and Capital Markets Union, available at https://data.europa.eu/doi/10.2874/30768

Daly Hassen, H. (2016) *Assessment of the socio-economic value of the goods and services provided by Mediterranean forest ecosystems: critical and comparative analysis of studies conducted in Algeria, Lebanon, Morocco, Tunisia and Turkey*, Food and Agriculture Organization of the UN and Plan Bleu pour l'Environnement et le Développement en Méditerranée, available at https://openknowledge.fao.org/server/api/core/bitstreams/7efc95fb-88b6-4d67-a4d2-ef9094346cfd/content

Dasgupta, P. (2021) *The Economics of Biodiversity: The Dasgupta Review*, HM Treasury, available at https://www.gov.uk/government/publications/final-report-the-economics-of-biodiversity-the-dasgupta-review

DEFRA (2023) *Enabling a Natural Capital Approach*, guidance, UK Department for Environment, Food & Rural Affairs, available at https://www.gov.uk/government/publications/enabling-a-natural-capital-approach-enca-guidance/enabling-a-natural-capital-approach-guidance

Deutz, A., G. Heal, R. Niu, E. Swanson, T. Townshend, Z. Li ... J. Tobin-de la Puente (2020) *Financing Nature: Closing the Global Biodiversity Financing Gap*, Paulson Institute, the Nature Conservancy, Cornell Atkinson Center for Sustainability, available at https://www.paulsoninstitute.org/wp-content/uploads/2020/10/FINANCING-NATURE_Full-Report_Final-with-endorsements_101420.pdf

ECA (2024) 'Green transition: Unclear contribution from the Recovery and Resilience Facility', *Special Report* 14/2024, European Court of Auditors, available at https://www.eca.europa.eu/ECAPublications/SR-2024-14/SR-2024-14_EN.pdf

ECB (2022) *2022 climate risk stress test*, European Central Bank, available at https://www.bankingsupervision.europa.eu/ecb/pub/pdf/ssm.climate_stress_test_report.20220708~2e3cc0999f.en.pdf

EIB (2023) *Investing in Nature-Based Solutions: State of Play and Way Forward for Public and Private Financial Measures in Europe*, European Investment Bank, available at https://data.europa.eu/doi/10.2867/031133

Elderson, F. (2024) 'Making banks resilient to climate and environmental risks – good practices to overcome the remaining stumbling blocks', speech at the European Banking Federation Executive Committee Meeting, 14 March, https://www.bankingsupervision.europa.eu/press/speeches/date/2024/html/ssm.sp240314~da639a526a.en.html

Engel, S., S. Pagiola and S. Wunder (2008) 'Designing payments for environmental services in theory and practice: An overview of the issues', *Ecological Economics* 65(4): 663-674, available at https://www.sciencedirect.com/science/article/abs/pii/S0921800908001420

European Commission (2016) 'Natural Capital Financing Facility: A guide for Applicants', available at https://climate.ec.europa.eu/system/files/2016-11/ncff_guide_for_applicants_brochure_en.pdf

European Commission (2021a) *EU Biodiversity Strategy for 2030*, available at https://op.europa.eu/en/publication-detail/-/publication/31e4609f-b91e-11eb-8aca-01aa75ed71a1

European Commission (2021b) 'Commission Staff Working Document: Guidance to Member States on Recovery and Resilience Plans', SWD(2021) 12 final, available at https://commission.europa.eu/system/files/2021-01/document_travail_service_part1_v2_en.pdf

European Commission (2022a) 'Impact Assessment Accompanying the Proposal for a Regulation of the European Parliament and of the Council on Nature Restoration', COM/2022/304 Final, available at https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52022SC0167&amp%3Bqid=1686750707844

European Commission (2022b) 'Environmental Implementation Review 2022: Turning the tide through environmental compliance', COM/2022/438 final, available at https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=comnat:COM_2022_0438_FIN

European Commission (2022c) 'A toolbox for reforming environmentally harmful subsidies in Europe', COM(438) final, available at https://op.europa.eu/en/publication-detail/-/publication/fb3eccdc-1f68-11ed-8fa0-01aa75ed71a1

European Commission (2023) 'Technical guidance on the application of 'do no significant harm' under the Recovery and Resilience Facility Regulation', C/2023/111 available at https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=OJ:C_202300111

European Commission (2024) 'Non-paper: financing biodiversity protection and restoration in the EU', 16 July, available at https://circabc.europa.eu/ui/group/6f30d1d2-d6f2-4c6e-a4dc-1feb66201929/library/77e43504-19da-44c3-97cd-dc1c53a42b7d/details

FAO (2020) *How the World's Food Security Depends on Biodiversity*, Food and Agriculture Organization of the United Nations, available at https://openknowledge.fao.org/server/api/core/bitstreams/60c9896f-6ed9-4b0e-982a-3d001a1ef2a6/content

Fripp, E. (2014) *Payments for Ecosystem Services (PES): A practical guide to assessing the feasibility of PES projects*, Center for International Forestry Research (CIFOR), available at https://www.cifor-icraf.org/publications/pdf_files/Books/BFripp1401.pdf

HM Treasury (2022) *The Green Book*, available at https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-government/the-green-book-2020

IAPB (2024) *Framework for high integrity biodiversity credit markets*, International Advisory Panel on Biodiversity Credits, available at https://www.iapbiocredits.org/framework

IPBES (2024) *The thematic assessment report on interlinkages among biodiversity, water, food and health: summary for policymakers*, Intergovernmental Platform on Biodiversity and Ecosystem Services, available at https://ipbes.canto.de/b/I0BBS

Johnson, J., G. Ruta, U. Baldos, R. Cervigni, S. Chonabayashi, E. Corong ... S. Polasky (2021) *The Economic Case for Nature: A Global Earth-Economy Model to Assess Development Policy Pathways*, World Bank, available at http://hdl.handle.net/10986/35882

Khalifa, S. A. M., E. H. Elshafiey, A. A. Shetaia, A. A. A. El-Wahed, A. F. Algethami, S. G. Musharraf, et al. (2021) 'Overview of Bee Pollination and Its Economic Value for Crop Production', *Insects*, 12:8, 688, available at https://doi.org/10.3390/insects12080688

Kurth, T., G. Wübbels, A. Portafaix, A. Meyer zum Felde and S. Zielcke (2021) *The Biodiversity Crisis Is a Business Crisis*, Boston Consulting Group, available at https://www.bcg.com/publications/2021/biodiversity-loss-business-implications-responses

Lok, M., E. Benson, M. Gough, S. Ahlroth, O. Greenfield, J. Confino and W. Wormgoor (2018) *Natural Capital for Governments: What, Why and How*, Government Dialogue on Natural Capital, available at https://portals.iucn.org/library/sites/library/files/resrecrepattach/GDNC2018-005-WS3-Natural-capital-for-governments-Final-04-02-2019_0.pdf

Marion, K., A. Hallosserie, J. Landry and N. Cozannet (2024) 'Lessons Learned from REDD+ for National Biodiversity Credit Schemes', *Policy Brief* 05/24, IDDRI, available at https://www.iddri.org/sites/default/files/PDF/Publications/Catalogue%20Iddri/Propositions/202410-PB0524-biodiversity%20credits.pdf

Merler, S. (2025) 'The EU sustainable finance framework', *Working Paper*, Bruegel, forthcoming

Moran, D. and C. Bann (2000) 'The Valuation of Biological Diversity for National Biodiversity Action Plans and Strategies: A Guide for Trainers', mimeo, prepared for the United Nations Environment Program (UNEP), available at https://www.cbd.int/financial/values/g-valueunepguide.pdf

Natural Capital Coalition (2021) *Natural Capital Protocol*, available at https://naturalcapitalcoalition.org/wp-content/uploads/2018/05/NCC_Protocol_WEB_2016-07-12-1.pdf

Nesbit, M., K. Whiteoak, E. Underwood, M. Rayment, K. Hart, G. Aubert ... G. Nicholls (2022) *Biodiversity Financing and Tracking: Final Report*, European Commission, IEEP and Trinomics, available at https://data.europa.eu/doi/10.2779/950856

Newbold, T., L. Hudson, S. Hill, S. Contu, I. Lysenko, R.A. Senior ... A. Purvis (2015) 'Global effects of land use on local terrestrial biodiversity', *Nature* 520 (7545): 45–50, available at https://doi.org/10.1038/nature14324

Nyasulu, M.K., I. Fetzer, L. Wang-Erlandsson, F. Stenzel, D. Gerten, J. Rockström and M. Falkenmark (2024) 'African Rainforest Moisture Contribution to Continental Agricultural Water Consumption', *Agricultural and Forest Meteorology* 346(109867): 1-11, available at https://doi.org/10.1016/j.agrformet.2023.109867

OECD (2017) *Green Growth Indicators 2017*, Organisation for Economic Co-operation and Development, available at https://doi.org/10.1787/9789264268586-en

OECD (2002) *Handbook of Biodiversity Valuation: A Guide for Policy Maker*s, Organisation for Economic Co-operation and Development, available at https://doi.org/10.1787/9789264175792-en

OECD (2024) *Tracking Economic Instruments and Finance for Biodiversity*, Organisation for Economic Co-operation and Development, available at https://www.oecd.org/content/dam/oecd/en/data/insights/data-explainers/2024/10/tracking-economic-instruments-and-finance-for-biodiversity-2024/OECD-Tracking-Economic-Instruments-and-Finance-for-Biodiversity-2024.pdf

Richardson, K., W. Steffen, W. Lucht, J. Bendtsen, S.E. Cornell, J.F. Donges ... J. Rockström (2023) 'Earth beyond six of nine planetary boundaries', *Science Advances*, 9(37), available at https://doi.org/10.1126/sciadv.adh2458

Roberson, E. (2008) *Nature's Pharmacy, Our Treasure Chest: Why We Must Conserve Our Natural Heritage*, Center for Biological Diversity, available at https://www.biologicaldiversity.org/publications/papers/Medicinal_Plants_042008_lores.pdf

Sanchez-Azofeifa, G.A., A. Pfaff, J.A. Robalino and J.P. Boomhower (2007) 'Costa Rica's payment for environmental services program: intention, implementation, and impact', *Conservation Biology* 21(5): 1165-1173, available at https://doi.org/10.1111/j.1523-1739.2007.00751.x

Schnabel, I. (2023) 'Monetary policy tightening and the green transition', speech at the International Symposium on Central Bank Independence, Sveriges Riksbank, Stockholm, 10 January, available at https://www.ecb.europa.eu/press/key/date/2023/html/ecb.sp230110~21c89bef1b.en.html

Schoenmaker, D. (2019) 'Greening monetary policy: An alternative to the ECB's market-neutral approach', *Bruegel Blog*, 21 February, available at https://www.bruegel.org/blog-post/greening-monetary-policy-alternative-ecbs-market-neutral-approach

Strategic Dialogue (2024) *Strategic Dialogue on the Future of EU Agriculture*, report to the European Commission, available at https://agriculture.ec.europa.eu/document/download/171329ff-0f50-4fa5-946f-aea11032172e_en?filename=strategic-dialogue-report-2024_en.pdf

Sustainable Fitch (2023) *Biodiversity in ESG: State of the Sustainable Finance Market*, Sustainable Insight, available at https://www.sustainablefitch.com/corporate-finance/biodiversity-in-esg-state-of-sustainable-finance-market-09-10-2023

Svartzman, R., E. Espagne, J. Gauthey, P. Hadji-Lazaro, M. Salin, T. Allen ... A. Vallier (2021) 'A "Silent Spring" for the Financial System? Exploring Biodiversity-Related Financial Risks in France', *Working Paper 826*, Banque de France, available at https://publications.banque-france.fr/en/silent-spring-financial-system-exploring-biodiversity-related-financial-risks-france

Thomson, D. (2024) 'Recommendations on how to determine the contribution of EU funds for biodiversity', *Briefing*, CEE Bankwatch Network, available at https://bankwatch.org/wp-content/uploads/2024/01/2024_01_How-to-determine-the-contribution-of-EU-funds-for-biodiversity.pdf

UNEP (2024) *Global Resources Outlook 2024*, UN Environment Programme and International Resource Panel, available at https://www.unep.org/resources/Global-Resource-Outlook-2024

van Toor, J., D. Piljic, G. Schellekens, M. van Oorschot and M. Kok (2020) *Indebted to Nature Exploring Biodiversity Risks for the Dutch Financial Sector*, De Nederlandsche Bank, available at https://www.dnb.nl/media/4c3fqawd/indebted-to-nature.pdf

Von der Leyen, U. (2024) 'Keynote speech by President von der Leyen at the DLD Nature Conference', 13 September, available at https://ec.europa.eu/commission/presscorner/detail/en/SPEECH_24_4668

WEF (2024) 'The Role of Corporate Philanthropy in Accelerating Climate and Nature Transitions', *White Paper*, World Economic Forum, available at https://www3.weforum.org/docs/WEF_The_Role_of_Corporate_Philanthropy_in_Accelerating_Climate_and_Nature_Transitions_2024.pdf

WEF and McKinsey (2023) *Biodiversity Credits: Demand Analysis and Market Outlook*, Insight Report, available at https://www3.weforum.org/docs/WEF_2023_Biodiversity_Credits_Demand_Analysis_and_Market_Outlook.pdf

World Bank (1993) 'Debt for Nature Swaps', *World Bank Information Briefs*, available at https://documents1.worldbank.org/curated/ar/572271478249749992/pdf/109380-BRI-WBG-PUBLIC-date-04-01-1993-Debt-for-Nature-Swaps.pdf

World Bank (2020) *Mobilizing Private Finance for Nature*, World Bank Group, available at https://thedocs.worldbank.org/en/doc/916781601304630850-0120022020/original/FinanceforNature28Sepwebversion.pdf

Wunder, S. (2024) *Biodiversity Credits under the Microscope*, Circular Bioeconomy Alliance, available at https://doi.org/10.62164/20243

Wunder, S. and E. Mauri (2023) 'How Can We Make Payments for Environmental Services Work?' *Policy Brief* 8, European Forest Institute, available at https://doi.org/10.36333/pb8

Wunder, S., J. Börner, D. Ezzine-de-Blas, S. Feder and S. Pagiola (2020) 'Payments for environmental services: Past performance and pending potentials', *Annual Review of Resource Economics* 12(1): 209-234, available at https://www.annualreviews.org/content/journals/10.1146/annurev-resource-100518-094206

Wunder, S., C. Fraccaroli, J.W. Bull, T. Dutta, A. Eyres, M.C Evans ... S. zu Ermgassen (2024) 'Biodiversity Credits: Learning Lessons from Other Approaches to Incentivize Conservation', mimeo, available at https://doi.org/10.31219/osf.io/qgwfc

WWF (2024) *Can Your Money Do Better? Redirecting Harmful Subsidies to Foster Nature and Climate Resilience*, World Wide Fund for Nature, available at https://wwfeu.awsassets.panda.org/downloads/wwf---harmful-subsidies-report_full-report.pdf